DEFENSE THREAT REDUCTION AGENCY

The Defense Threat Reduction Agency (DTRA) is seeking small businesses with a strong research and development capability and experience in weapons effects, phenomenology, operations and counterproliferation. (Please note, DTRA is not interest in weapon development, design or manufacture.) DTRA invites small businesses to send proposals to the following address:

Defense Threat Reduction Agency
ATTN: AM/SBIR
45045 Aviation Drive
Dulles, VA 20166-7517

The proposals will be processed and distributed to the appropriate technical offices for evaluation. Questions concerning the administration of the SBIR program and proposal preparation should be directed to:

Defense Threat Reduction Agency
ATTN: AM/SADBU, Mr. Bill Burks
6801 Telegraph Road
Alexandria, VA 22310-3398
Tel: (703) 325-5021
E-mail: Billy.Burks@hq.dswa.mil

DTRA has identified 17 technical topics numbered DTRA 99-001 through DTRA 99-017. These are the only topics for which proposals will be accepted. The current topics and topic descriptions are included below. These topics were initiated by the DTRA technical offices which manage the research and development in these areas. Several of the topics are intentionally broad to ensure any innovative idea which fits within DTRA's mission may be submitted. Proposals do not need to cover all aspects of these broad topics. Questions concerning the topics should be submitted to:

Defense Threat Reduction Agency
45045 Aviation Drive
Dulles, VA 20166-7517
Tel: (703) 325-6475
E-mail: ronald.yoho@hq.dswa.mil

DTRA selects proposals for funding based on the technical merit, criticality of the research, and the evaluation criteria contained in this solicitation document. As funding is limited, DTRA reserves the right to select and fund only those proposals considered to be superior in overall technical quality and filling the most critical requirements. As a result, DTRA may fund more than one proposal under a specific topic or it may fund no proposals in a topic area. Proposals which cover more than one DTRA topic should only be submitted once.

While funds have not specifically been set aside for bridge funding between Phase I and Phase II successful proposals, the potential offeror is advised to read carefully the conditions set out in this solicitation for FAST TRACK Phase II awards. Gap funding will not be considered for other Phase II awards.

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DEFENSE THREAT REDUCTION AGENCY
FY 1999 SBIR TOPIC DESCRIPTIONS

DTRA 99-001 TITLE: Radiation Hardened Optics

KEY TECHNOLOGY AREA: Materials/Optics

OBJECTIVE: DoD needs innovative sensors that integrate optical and electrical components to mitigate laser and nuclear effects without degrading sensor performance.

DESCRIPTION: Many optical systems require both laser and radiation hardening. Low temperature filter coatings can be applied to operating focal plane arrays, to reduce the threat of dazzle and provide radiation hardening while maintaining the sensor performance. Innovative and testable coatings are possible today.

PHASE I: Develop a methodology for selecting low temperature coatings that can be applied directly to a functional focal plane array. Demonstrate required material properties (band pass filter, reduced defect formation, yield and stress measurements). Provide a test plan that can demonstrate laser dazzle reduction and radiation hardness to cold and hot x-rays of the smart sensor.

PHASE II: Fabricate the coating over an existing calibrated sensor. Develop in-situ testing required to verify improved characterization of the coated sensors. Develop a model for the threshold or on-set of radiation effects. Provide test data to validate theoretical model from at least two simulators while tracking a blackbody target and exposed to Nd:YAG laser.

PHASE III DUAL USE APPLICATIONS: Smart optic applications can be used for various space platforms for monitoring solar flares and environmental problems.

KEYWORDS: Radiation/Laser Hardened Optical filters, X-ray/laser hardened optical materials

REFERENCES: Rugates

DTRA 99-002 TITLE: Magnetic Flyer Plate Technology

KEY TECHNOLOGY AREA: Nuclear, Chemical and Biological Defense

OBJECTIVE: Develop innovative technologies for advancing the state of the art in nuclear survivability testing for full scale reentry bodies or components subjected to the cold x-ray threat and resulting shock/impulsive loading using magnetic flyer plates.

DESCRIPTION: The DTRA Magnetic Flyer Plate facility performs subscale to fullscale testing to provide dynamic mechanical loads (in the kilobar range) of specified uniformity and planarity for various geometrical shapes. The quality of testing could be enhanced in several areas: pulse power technology as related to faster crowbar systems; improving reproducibilty of flyerplate planarity; developing fieldable flyer plate systems insensitive to tolerances of 0.001 inches; developing an aft end testing capability; developing a capability to monitor flyerplate velocities over a large area versus discrete points.

PHASE I: build a prototype instrument or system to demonstrate its performance and potential enhancing full scale testing. The prototype could be demonstrated using the DTRA Magnetic Flyer Plate facility.

PHASE II: design build and test a full scale instrument or system, and integrate with the existing DTRA facility. This may involve coordination with DTRA to schedule testing in the simulator.

PHASE III DUAL USE APPLICATIONS: In addition to the applications cited for advancing the state of the art in impact testing the technologies could be used for commercial subscale impulsive loading, blasting, structural integrity studies, and material model development.

REFERENCES:
(1) Glasstone and Dolan, The Effects of Nuclear Weapons, 1977
(2) DNA EM-1, Capabilities of Nuclear Weapons

KEYWORDS: Impact testing, Pulse Power, Shock, X-Rays, Penetration Mechanics, Capacitors, Velocity measurements, Dielectrics, Impulsive loading, TOA, Flyer Plate, Diagnostics, Electromagnetic Pulse, Nuclear Weapons Effects.

DTRA99-003 TITLE: Electromagnetic (EM) Hardening Technology Development

KEY TECHNOLOGY AREA: Electromagnetic (EM) Hardening Technologies

OBJECTIVES: Develop and demonstrate innovative and affordable electromagnetic hardening technologies and methodologies for integrated protection of military systems and COTS equipment with emphasis on mitigating high altitude electromagnetic pulse (HEMP) and high power microwave (HPM) effects. Technologies that are integral to a balanced system hardening approach (e.g., cost, performance, weight, and life cycle) are desirable.

DESCRIPTION: The Department of Defense has a requirement to ensure survivability of key military C3 and weapons systems against the effects of HEMP and emerging RF weapons threats. SECDEF has initiated a mandate to transition a 25% COTS/75% MILSPEC equipment ratio in military systems to 75% COTS/25% MILSPEC. At the same time, budgets for military procurements are undergoing drastic reductions. A key challenge is to ensure that this COTS equipment is survivable to the wide range of existing and emerging battlefield EM environments.

The following characteristics of EM hardening technologies for military systems and COTS applications are most desirable: (1) lightweight, high performance shields and protective devices; (2) integrated EM design, protection, and test techniques; (3) affordability; (4) efficient test methods; (5) field expedient hardening and testing techniques; (6) very low maintenance protective devices (e.g., transparent to user). The technology development process for this solicitation is divided into 3 phases as shown below.

PHASE I: Demonstrate the feasibility of the proposed technology or integrated technologies by deriving an approach and generating a preliminary design.

PHASE II: Resolve remaining technical issues and optimize design parameters. Demonstrate proposed technology through prototype testing. Provide detailed design and manufacturing specifications.

PHASE III DUAL USE APPLICATIONS. These electromagnetic hardening technologies are essential to effective protection of military systems. They will also prove useful in many commercial shielding and EM interference applications, especially those involving COTS equipment.

KEYWORDS: Balanced EM hardening, integrated protection, COTS hardening

DTRA99-004 TITLE: Radiation Tolerant Microelectronics and Photonics Technology Development

KEY TECHNOLOGY AREA: Radiation tolerant semiconductor technology

OBJECTIVE: The objectives of this program are to develop and demonstrate:
(1) technology to support the fabrication of radiation tolerant microelectronics and photonic devices and semiconductor materials (e.g. silicon-on-insulator material, etc.); (2) radiation hardness assurance methods and technology; (3) diagnostics to characterize the radiation response and sensitivity to radiation effects of semiconductor materials and devices; (4) electronic design automation (EDA) methods to design radiation effects in semiconductor devices and materials and; (5) unique semiconductor structures and materials capable of providing enhanced radiation and electrical performance (e.g., Tbit data transmission and storage, etc.).

DESCRIPTION: High performance, affordable and radiation tolerant microelectronics and photonics are required to support a wide variety of DoD and commercial missile and spacecraft applications. The availability of advanced semiconductor technology is critical to both defense and economic security of the US. There is a critical need for very high throughout microprocessors, large storage devices, reconfigurable logic circuits, wideband data transmission devices, multiwavelength sensors, etc. for advanced systems such as Space Based Laser, Space Based Radar and on the scientific side the upcoming Hubble replacement. Thus, we are looking for innovative solutions to ensure the availability of these and other advanced semiconductor technologies to meet the stringent performance, power, weight, reliability and radiation requirements of the above mentioned and other DoD and other government organizations systems.

PHASE III DUAL USE APPLICATIONS: The microelectronics, photonics and semiconductor material technology that will be developed under this program is applicable to military, scientific and commercial spacecraft. Radiation tolerant technology is required to meet the stringent requirements of the natural space environment as well as environments that might be engendered

by nuclear weapon effects. Moreover, modern commercial spacecraft also have very stressing power, weight, reliability and performance needs.

KEYWORDS: radiation tolerant microelectronics, radiation hardened microelectronics, radiation tolerant photonics, radiation hardened photonics, radiation hardness assurance

DTRA 99-005 TITLE: Atmospheric Nuclear Effects Modeling

KEY TECHNOLOGY AREA: Modeling and Simulation

OBJECTIVE: Develop new and unique techniques for :

1. more rapidly predicting nuclear weapon phenomenology and/or nuclear effects/impacts on the operation of communications, radar or optical sensors or
2. derive new algorithms which will be able to more accurately describe/predict system impacts at current prediction speeds, or
3. a combination of both above.

These effects include, but are not limited to, nuclear burst phenomenology at all altitudes, the resulting impact on RF propagation on communications, radar and C3I operations and induced optical background impacts on optical sensors from UV through LWIR.

DESCRIPTION: Research on nuclear explosion induced phenomenology in the earth's atmosphere has a long history dating back to the Manhattan Project in the 1940's. In general the scope and detail of our predictive capability has been limited by basic knowledge, limited test data and computational facility. Over the last 40 years we have gained extensive knowledge in the areas of physics, chemistry and mathematical techniques and we have seen a tremendous increase in computational capability. (Current PC capability has outstripped the CRAY 1 of 15 years ago.) Despite the current computer power available, current computer models still make compromises when investigating nuclear phenomenology development and system impact. We still don't have complete knowledge of all the pertinent effects. Current models stress either very fast computational time for real time modeling or very detailed analyses in specific areas.

We are looking for new methods for computing nuclear burst phenomenology and nuclear burst effects on system elements and/or on combined elements. These methods may trade predictive accuracy for computational speed, but both accuracy plus speed are the ultimate desire. These methods may entail unusual ways of determining the required data or ways of more rapidly processing already calculated and stored results.

PHASE III DUAL USE APPLICATIONS: Some of the calculation tools previously started on SBIR funds have been applied to complex modeling and analysis of satellite communication. Similar techniques might be applicable to radar and optical systems design and evaluation in a naturally occurring environment as well as in the nuclear arena.

REFERENCES: Pertinent documentation in this area is either classified or has distribution limitations. Interested parties can contact the POC for specific data or references consistent with their need to know and/or contractor status.

KEYWORD: nuclear, rf, satellite communications, phenomenology, optical systems, radar

DTRA 99-006 TITLE: Smart Archive Search and Presentation Tools

CATEGORY: Applied Research, Computing and Software (intelligent systems, user interface)

OBJECTIVE: Research and Develop innovative new technologies for the intelligent search, presentation, relating and display of data and objects within the DTRA DARE digital archive.

DESCRIPTION: DTRA is currently archiving its comprehensive collection of unique and irreplaceable nuclear weapon effects information in the Data Archival and Retrieval Enhancement (DARE) system. This legacy information takes such varied forms as reports/documents, photographs, film, waveforms, tables and diagrams. Data is currently searched and accessed using Internet search technology and displayed through a web-browser interface. While there are a plethora of Internet search engines and related knowledge and display tools, few deal very effectively with the broad range of data types present in DARE, nor do they generally provide interfaces or plug-ins for on-line analysis capability or Thesauri. The objective of the research effort will be to provide innovative solutions to improving the search, analysis and display capabilities of DARE, especially in improving the system search capability across all data types and integrating data analysis tools into the system. In the post-Cold War environment with no new data from nuclear testing expected and nuclear data experts rapidly retiring, the ability to

use DARE to rapidly find, effectively and intuitively display, correlate and analyze this material, particularly the numeric data, is increasingly crucial to future research efforts which rely heavily on simulations and high fidelity calculations coupled with correlation with the archived data.

PHASE I: demonstrate the proposed concept and the feasibility of incorporating the proposed technology into DARE through a working prototype or mock-up. A Phase II implementation plan should be provided.

PHASE II: develop the proposed technology and assist the developer with implementing the technology into DARE's search and navigation mechanisms.

PHASE III DUAL USE APPLICATIONS: Improved archive search technologies apply directly to a large and fast growing civilian market involving digitized workflow, data archiving and data mining technologies. A possible follow-on would be to adapt the technology to access remote databases and archives.

KEYWORDS: Digital Archive, expert systems, expert interface, intelligent queries, natural language, knowledge navigation, data archival and retrieval.

DTRA 99-007 TITLE: Automated data capture and metadata creation for a digital data archive

CATEGORY: Applied Research, Computing and Software (software and systems development)

OBJECTIVE: Explore and develop innovative, automated and low-cost methods for the digital capture and creation of associated metadata for a data archive.

DESCRIPTION: The digital capture and storage of documents into the Defense Threat Reduction Agency's data archival system has proven to be slower and more costly than anticipated. In particular, the creation of metadata labels for the digitally captured documents and material, a manual and time intensive process, has limited archive population. While information for label creation is available from different digital sources such as the agency's STILAS database, data integrity issues have limited implementation of this information into metadata labels.

PHASE I: research will demonstrate the feasibility of an automated method for creation of archive metadata labels which significantly improves the rate of metadata label production.

PHASE II: implement the developed technology and procedures into the DTRA's data archiving effort.

PHASE III DUAL USE APPLICATIONS: Suggested research is applicable to many current data transfer problems in both government and civilian sectors such as transferring data between dissimilar databases and tools for linking remote archives with different metadata.

KEYWORDS: Digital Archive, metadata, data capture and storage, data archival and retrieval, scanning.

DTRA 99-008 TITLE: Use Of Digital Video For Archiving Technical Information

CATEGORY: Applied Research, Computing and Software (software and systems development, user interface)

OBJECTIVE: Explore and develop innovative methods for storing, retrieving, displaying and transferring digital video for use in DTRA's digital archive program.

DESCRIPTION: As part of its stewardship program, the Defense Threat Reduction Agency is involved in the digital archival of video. This effort includes capturing legacy film, but also includes the videotaping of experts involved in technical discussions germane to Nuclear Weapons Effects research. Storing digitized video, searching and analyzing the subject film and associated audio and transferring these typically large files are challenging research areas which offer a large return in the capability of data archival systems to maintain useful video collections.

PHASE I: research will demonstrate the feasibility of a proposed technology to improve digital video archiving.

PHASE II: implement the developed technology and procedures into the DTRA's data archive system.

PHASE III DUAL USE APPLICATIONS: Suggested research is applicable to many current data transfer and archival problems in both government and civilian sectors. Follow on applications might include x-ray diagnosis/analysis tools and smart military imagery analysis tools for targeting.

KEYWORDS: Digital Video Archive, data streaming, video compression, video search.

DTRA 99-009 TITLE: Nuclear Weapons System and WMD Demilitarization Safety Assessments/Special Studies

KEY TECHNOLOGY AREA: Exploratory Development, Safety

OBJECTIVE: Improved safety of US nuclear weapons systems and WMD demilitarization operations.

DESCRIPTION: Quantifying, reducing, and managing the risks associated with the life-cycle management of military nuclear weapons systems and weapon demilitarization is of vital importance. New and innovative concepts to improve on traditional probabilistic risk assessment techniques and methodologies, as well as operations are desired to increase the overall safety of these assets. Abnormal environments that these systems may encounter include mechanical insults (e.g., drops, vehicle accidents), thermal insults (e.g., fuel fires), electrical insults (e.g., lightning, electrical power), and combinations of these environments. Long range program thrusts include characterizing these abnormal environments, analyzing human factors and developing quick running models to allow decision makers to manage safety risks. Concepts should employ innovative ideas and make use of new and emerging technologies. Work will include measuring risk improvements, risk reduction techniques, and advanced algorithms for improved quick-look capabilities. Measures to improve the safety of nuclear weapons systems and demilitarization operations against all possible abnormal environments are required. Safety enhancement measures include prediction of the likelihood of adverse events through characterization of initiators and eliminating/mitigating such initiators. Proposals should describe how they will improve protection against known and predicted risks and should emphasize risk elimination/reduction where appropriate.

PHASE I: demonstrate the feasibility and potential usefulness of the proposed safety technologies/techniques.

PHASE II: fully develop the proposed technologies/techniques so they can be compared to existing techniques.

PHASE III DUAL USE APPLICATIONS: Data and models from an activity such as this SBIR area have potential for adaptation to a variety of users. Risk is a common concept used in commercial activities as varied as finance and insurance to transportation networks and major engineering projects. Minimization of risk is important in many occupations, such as manufacturing. Risk models can be used in evaluating alternatives, optimizing safety budgets and equipment design, as well as reducing risks in the work place/home or comparing alternative decisions. The quantification and understanding, as well as the reduction or elimination of risks can be used to increase the continued viability of many commercial endeavors.

KEYWORDS: Safety, Risk, Nuclear Weapons, Abnormal Environments, mechanical, thermal, electrical, human factors, modeling, risk reduction, accident initiators, Probabilistic Risk Assessment, risk elimination, risk mitigation

DTRA 99-010 TITLE: CW/BW Detection Using Novel Sensor Technologies

KEY TECHNOLOGY AREAS: Primary Area is *Sensors*; Secondary area is *Chemical and Biological Defense*

OBJECTIVE: Improve/develop US technical capability to demonstrate its compliance, and verify/monitor compliance of other states, with existing and future arms control treaties and agreements including: the Chemical Weapons Convention (CWC), Bilateral Destruction Agreement (BDA), Biological Weapons Convention (BWC), and the Joint US/UK/Russian Statement on Biological Weapons.

DESCRIPTION: New verification technologies and methods will be required to accurately monitor treaty compliance. The development of chemical and biological sensors is needed to facilitate on-site sample collection and preparation, screening and analysis. Sample screening is required to identify appropriate sample collection locations that have potential for containing key target analytes in water, soil, or air matrices, and to prioritize those collected samples for further determinative analysis. Sensors will be developed to conduct simultaneous detection of multiple chemical compounds, or biological agents and toxins, in a given treaty area. Sensors will be designed to permit the identification of target molecules, biological agents, or toxins in the presence of numerous interferents. The device must be portable and rugged for on-site field use. Sensors must achieve the necessary level of specificity to eliminate false-positive responses, while achieving state-of-the-art sensitivity level (e.g., minimum of 1-10 ppm for sample screening for chemical compounds). Sensor performance will be characterized by stability, reliability, reproducibility, and usability. Sensor technologies and assays must be robust in performance and engineering.

PHASE I: Demonstrate the feasibility of the proposed technology to detect/discriminate chemicals, biological agents, biological molecules and toxins applicable to chemical and/or biological arms control treaties and agreements.

PHASE II: Develop proof of concept and reduction to practice to demonstrate the proposed technology; prototype instrument.

PHASE III: Dual Use Applications: Chemical monitoring systems; environmental on-site analysis for site remediation/hazardous waste clean-up.

REFERENCES: The following web sites may be useful in obtaining relevant background information about the CWC and BWC.

1. http://www.opcw.nl
2. http://www.acda.gov
3. http://www.osia.mil
4. http://www.dswa.mil
5. http://pmaweb.hq.dswa.mil

DTRA 99-011 TITLE: Tracking Atmospheric Plumes Based on Stand-Off Sensor Data

KEY TECHNOLOGY AREA: Computing and Software

OBJECTIVE: Develop an approach to identifying and locating the source of nuclear events that generate atmospheric plumes by backtracking their atmospheric plumes.

DESCRIPTION: At present, a worldwide network of radionuclide monitoring stations with a spacing of several hundred km. is being set up to monitor radioactive fall-out from atmospheric nuclear tests under the Comprehensive Test Ban Treaty (CTBT). These stations sample the air for radioactive particulates and radioactive Xenon on a daily basis. To interpret the results, a means of estimating where any suspicious radionuclides might have originated is needed. DTRA seeks a software system that will allow an assessment of where the air parcels sampled by a monitoring station may have come from. Ideally, an accuracy of 1,000 sq. km. would be desirable. The system should take account of the properties of the radionuclides involved (e.g., settling, washout by rain, chemical reactions) as well as weather patterns. Appropriate historical data to test the system should be identified, and such a test should be part of the proposed work. Off-line analysis is envisaged, both automated or interactive systems, or both, will be considered. The system is being considered for the Prototype International Data Center (PIDC) presently being developed for the CTBT, and should be able to use the type of data being produced at the PIDC.

PHASE III DUAL USE APPLICATIONS: Atmospheric monitoring of pollutants from fixed sources, such as power plants (nuclear and non-nuclear)

KEYWORD LIST: radionuclide, atmospheric plumes, backtracking, atmospheric nuclear tests, fall-out, weather, pollutants.

DTRA 99-012 TITLE: Improved Seismic Location Procedure(s)

KEY TECHNOLOGY AREA: Computing and Software, ChemBio

OBJECTIVE: Conduct innovative research and develop new tools to locate man-made or natural seismic events using realistic (3-dimensional) velocity structure and either (1) surface sensors at near-regional or regional distances or (2) borehole sensors at local distance (i.e., within the testbed).

DESCRIPTION: Seismic location is one of the most challenging problems in monitoring a Comprehensive Test Ban (CTB). For events at low threshold, the effects due to lateral heterogeneity in the crust becomes apparent and the conventional methods of relying on a global 1-dimensional velocity model (such as J.-B. model) and exclusively teleseismic recordings may not work. As the problem shifts from teleseismic setting to a regional one, new and demanding computational requirements arise. This research initiative seeks innovative approaches that address various aspects of the seismic location problem in the CTBT era: the crustal structure is complex, 3-dimensional, the seismic network is sparse with a possibly skew configuration, need to use regional phase exclusively, etc.

PHASE I proposals should respond to at least one of the following areas:

(1) Develop innovative concepts as how to use a hypothetical 3-dimensional velocity structure and arbitrary selected hypocenter. The procedure must be capable of efficiently handling the computation of travel times to be used in the iterative inversions. Note that many published algorithms only provide the travel time for the first arrival or utilize the first arrivals in inversion. What is being sought under this initiative is a location algorithm that can fully exploit the secondary arrival picks as well, particularly at regional distances. (The development of efficient forward computation algorithm for secondary phases can be pursued as a separate research project, if appropriate.)

(2) If seismic events are clustered, then simultaneously determining the epicenters, average 1-dimensional velocity model as well as station correction (relative to the resulting 1-D model) is possible. An improved and well-tested software package would be useful whether at local, regional or global scale.

PHASE II depends on the specific subtopic the contractor chooses under the Phase I effort. The effort (product) can be one of the following: (a) a location module that can be incorporated into the data analysis system at the U.S. National Data

Center (U.S. NDC) and the International Data Center (IDC) for monitoring a CTBT, and (b) a software package that can be used in intrusive damage analysis, such as the effectiveness study of hard-target penetrator.

PHASE III - DUAL USE APPLICATIONS: Rockbust / mining collapse monitoring in underground mines, Earthquake hazards reduction, military applications (e.g., penetrator testbed).

KEYWORD LIST: location, inversion, seismic data, geophone data, environmental

DTRA 99-013 TITLE: Universal Seismic Event Discrimination System

KEY TECHNOLOGY AREA: Computing and Software

OBJECTIVE: Develop a robust special event analysis subsystem for the discrimination and identification of suspicious seismic events.

DESCRIPTION: The U.S. is developing a global system for monitoring nuclear proliferation activities and for potential use in verifying compliance with a CTBT. The system will collect data from a world-wide network of seismic stations and arrays for tens of thousands of detected earthquakes and explosions per year. Some events may be suspicious due to their location and depth and will warrant further analysis and a review of the results of the automated system. This initiative seeks subsystems for special event analysis and discrimination. Key elements will include: portability and versatility; operating system platform-independent; communication software for retrieving waveform and other data over the internet; a ground truth database for waveform comparison; regional velocity models and station/source calibration tables; location codes; synthetic seismogram programs; mapping and waveform display software. These and other elements should be integrated into a single menu driven system with a user-friendly interface.

PHAE III - DUAL USE APPLICATIONS: The subsystem will be based on platform-independent software components (including a Java graphical interface), and thus be available in the more popular PC market as well as UNIX.

DTRA 99-014 TITLE: Development of Multi-dimensional Databases for Rapid Processing of CTBT Monitoring Data

KEY TECHNOLOGY AREA: Computing and Software

OBJECTIVE: Develop efficient database application to improve the exploitation of very large database for monitoring the Comprehensive Test ban Treaty

DESCRIPTION: Nuclear monitoring data are currently stored in relational databases, and they are accessed and manipulated using the SQL language. This kind of database is far from efficient for performing complex operations, especially mathematical ones, on the data that are stored within them. These complex operations require an altogether different type of database that is best suited for this application. DTRA seeks to investigate whether multi-dimensional databases are better suited than are relational databases for performing the types of operations which scientists must perform routinely in order to verify compliance with a CTBT. It is hoped that the technology shall focus to expedite the mathematical analysis of the databases, so as to make it easier for scientists to exploit the contents of very large databases for nuclear monitoring tasks, such as identifying anomalous events. A multi-dimensional database shall be designed and populated with data from the relational databases at the Center for Monitoring Research utilizing a product that is compatible to the database engine currently used at the PIDC. Software applications shall be designed to conduct complex operations on the database. The utility of this technology shall be evaluated by testing its efficiency for conducting the same analyses of nuclear monitoring data as are currently performed by conducting SQL queries of the relational databases at the PIDC.

KEYWORD LIST: Database management

DTRA 99-015 TITLE: Multi-Dimensional Visualization of Data to Identify Seismic Events or for Other Complex Multi-Dimensional Data Problems

KEY TECHNOLOGY AREA: Computing and Software

OBJECTIVE: Develop a visualization subsystem for the discrimination of different types of detected seismic events; test the subsystem with the Nuclear Treaty Programs Office's (NTPOs) Intelligent Monitoring System; and demonstrate the subsystem's potential application to other multi-dimensional data problems.

DESCRIPTION: DoD is developing a global system for monitoring nuclear proliferation activities and for potential use in verifying compliance with a Comprehensive Nuclear Test Ban Treaty (CTBT). The system will collect data from a worldwide network of seismic stations and arrays, as well as sensors deployed for air, particulate, and other types of environmental sampling. The seismic system alone will have to process data from several hundred monitoring stations for tens of thousands of detected earthquakes and explosions per year. Results of the final analysis must be available within 24-48 hours of the occurrence of the events. Achieving this goal within the available resources will require automatic data processing and an enhanced data interpretation capability. NTPO is exploring technologies such as machine learning, machine discovery, and visualization methods to aid in the data interpretation.

This initiative seeks subsystems implementing novel visualization techniques and components to aid in interpreting the results of multivariate seismic discrimination analysis, particularly for small seismic events detected at regional distances out to 2,000 km. The subsystems will be installed in the Intelligent Monitoring System at NTPO's Center or Monitoring Research (CMR) located in Rosslyn, Virginia, and tested with data acquired and processed by the Intelligent Monitoring System. The performer will demonstrate how the visualization techniques can be applied to the general problem of monitoring the proliferation of weapons of mass destruction by demonstrating that it is capable of aiding human analysts in interpreting data from the global seismic monitoring system.

PHASE III - DUAL USE APPLICATION: Visualization subsystem to aid in the solution of generic multi-dimensional or multivariate problems. This could include topics ranging from environmental monitoring to air traffic control.

DTRA 99-016 TITLE: Wide Area Detection (WAD) and Mapping Technologies for Locating Minefields Containing Anti-Personnel Landmines (APL)

KEY TECHNOLOGY AREA: Computing, Software, and Sensors

OBJECTIVE: Develop a US technical capability to detect and map APL minefields as part of a verification/monitoring regime of potential APL agreement/ban treaties, including Convention on Conventional Weapons (CCW) – Modified Protocol II, Ottawa Convention on APL Ban, and Conference on Disarmament (CD) Process for APL Ban.

DESCRIPTION: The US government has a long-range goal of banning use, export, stockpiling and production of all types of APL. The purpose of this ban is to reduce or eliminate post-war civilian casualties. The Defense Threat Reduction Agency (DTRA) has the responsibility to provide RDT&E support to all arms control treaties including the APL ban that is being currently pursued. As part of the APL ban treaty verification and/or monitoring requirements and the need for treaty required technical assistance toward demining, DTRA is seeking safe, cost-effective, and reliable technologies for wide area detection. DTRA has reviewed the programs of other U.S. government offices (SO/LIC, NVESD, JUXOCO as shown in the references) in the area of mine detection, and found that in these programs there is more emphasis on individual mine detection and clearance than on wide area detection and mapping of APL minefields. The DTRA effort is to detect APL minefields safely, rapidly and with high probability in order to meet future treaty mission needs. The system or technology to be developed will be used to verify a proposed ban on use of APL and for technical assistance in demining. The verification process could involve monitoring large areas of the world to validate reported APL minefield boundaries and to inspect new suspected deployments of APL as well as any expansions of existing minefields.

The potential need of DoD and DTRA regarding an APL ban treaty is to develop a proof of concept of a system to detect and map APL minefields. This total effort may be subdivided into different technology developments. The potential bidders are encouraged to offer solutions to one or more of the following technology areas:

1. One technology development area includes a stand-off sensor or combination of sensors and /or data fusion techniques to improve probability of detection of APL minefields. Key candidate sensors are likely to be ground penetrating radar (GPR), infrared line scanner (IRLS), electro-optical or electromagnetic sensor, and other sensors based on chemical technologies. An innovative approach to data fusion from multiple sensors is likely to be needed to meet desired performance levels.
2. Another area is the technology to convert the minefield boundary data to a geo-reference for generating a map useful to deminers and treaty verification inspectors.

3. The third area of technology development is the development of a suitable low-altitude aerial platform (UAV, small aircraft, helicopter, etc.) in support of wide area detection and to carry multiple sensors probably over rough and varied terrain.

The following characteristics of the wide area detection technologies for APL ban application are most likely: 1) high probability of detection of minefields containing metallic and non-metallic APLs, 2) no real time requirement of display or processing of data, 3) large area coverage, 4) cost-effective operations, and 5) no military threat during detection. The technology development for any of the three areas for this solicitation is divided into the following phases:

PHASE I: Demonstrate the feasibility of the proposed technology or combination of technologies by providing an approach and producing a preliminary design of the proposed system to assist in detection of minefields for the purpose of detecting presence or confirming absence of APLs.

PHASE II: Develop proof of concept to demonstrate the proposed technology. Install prototype device on an aerial platform to carry out demonstrations and tests over APL minefields. Submit a final prototype design of the proposed system.

PHASE III DUAL USE APPLICATIONS: Detection of unexploded ordnance (UXO) as part of military base clean-up operations in the US, in addition to treaty applications. The expected users of this technology are the US government implementers of an APL ban treaty or agreement.

REFERENCES:

1) GAO Report on UXO, Report No. 95-197, 20 Sep 1995
2) "Review & Identification of DOE Laboratory Technologies for Countermine/Unexploded Ordnance Detection" Cyrus Smith, Oak Ridge National Lab, December 2, 1996 (Re-issued on December 2, 1997).

KEYWORD LIST: Anti-Personnel Landmine (APL), APL Ban Treaty, Stand-off Detection, Minefield, Sensor, Data Fusion, Mapping

DTRA 99-017 TITLE: Unified Human Response to NBC Risk and Injury Model

KEY TECHNOLOGY AREA: Nuclear Weapons Lethality

OBJECTIVES: (1) To extend the applicability of the nuclear weapon effects-human response models that serve as the basis for US and NATO doctrine to include non-performance degrading effects. (2) To expand existing symptom-based human response models to include cognitive, combined injury, and risk-based data.

DESCRIPTION: The Defense Threat Reduction Agency is soliciting Small Business Innovative Research proposals to extend its existing symptom-based human response models to include cognitive, combined injury, and risk-based data. The existing models serve as the basis for US and NATO doctrinal estimates of operational and medical-load military casualties from general nuclear war. The SBIR proposals are requested to address the requirement to extend the models to address operational and health risks associated with potential missions in contaminated areas for other than general nuclear war. The proposed efforts will require collaborative research and coordination within the US and NATO research communities for related programs. However, the effort is specifically driven by published operational requirements. Specific topics include:

Unification of risk-based and performance-based human response models

Extension of primarily military population data to general population data

Effects of low-level protracted radiation on cognitive processes and representations suitable to estimate potential impacts or risks to operations

Combined injury (radiation and other insults)

Non-invasive verification and validation approaches

PHASE III DUAL USE APPLICATIONS: Directly translatable into the civil community for use with the FEMA-Congressional initiative for disaster resistant communities.

KEYWORD LIST: Human Response, risk-based modeling